

DX Series

Simple operation, approved function

- PID auto tuning
- Select direct action / reverse action internally
- High and low alarm output
- Control loop break alarm
- Decimal point display and high / low setting limitation
- Retransmission output



●● Suffix code

Model	Code					Description
DX	☐	☐	☐	☐	☐	Digital temperature controller
Dimension	2					48(W) x 96(H) mm
	3					96(W) x 48(H) mm
	4					48(W) x 48(H) mm
	7					72(W) x 72(H) mm
	9					96(W) x 96(H) mm
Input	K					K thermocouple
	J					J thermocouple
	R					R thermocouple
	D					RTD (KPt 100 Ω)
	P					RTD (Pt 100 Ω)
	V					1 – 5 V DC
	C					4 – 20 mA DC
	F					0 – 10 V DC
Control output	M					Relay contact output
	C					Current output (4 – 20 mA DC)
	S					SSR (voltage pulse output, 12 V DC)
Alarm output	S					Alarm output 1 contact (model : DX4)
	W					Alarm output 2 contact (all models except DX4)
Optional	A					Retransmission output (4 – 20 mA DC, measured value)
	N					None (DX4, DX7 No retransmission output)
Control operation ※ selection by SL9 (initial value : R)	R					Reverse action (heating control)
	D					Direct action (cooling control)
Power Supply Voltage	•					No indication (100 – 240 V AC)
	C					24 V DC / AC

Specification



Input

Thermocouple	K, J, R
RTD input	KPt 100 Ω , Pt 100 Ω
DC rated voltage	1 – 5 V DC, 0 – 10 V DC, 4 – 20 mA DC
Input sampling time	250 ms
Input display resolution	Less than 1 C in standard (less than 0.1 C in decimal point range)
Input impedance	Thermocouple and DC rated voltage: min 1M Ω , DC voltage input: approx 1 M Ω
Allowable signal source resistance	Thermocouple–(max 250 Ω), DC voltage (max 2 k Ω)
Allowable wiring resistance	RTD max 10 Ω (however resistance among 3 wires should be same)
Allowable input voltage	± 20 V DC for 1 min
Input compensation	± 100 % of FS.
Input scaling	–1999 ~ 9999 (within range of SL12 ~ SL13, but only with voltage and current input)
Cold junction compensation error	± 3.5 $^{\circ}\text{C}$ (between 0 ~ 50 $^{\circ}\text{C}$)
Input signal break detection	UP Scale

Performance

Display accuracy	± 0.5 % of FS but, ± 1 % of FS with rated voltage
Retransmission output accuracy	± 0.2 mA DC (resistive load max 600 Ω , output range 3.2 – 20.8 mA DC)
Insulation resistance	Min 20 M Ω (500 V DC), input terminal–Power terminal, power terminal–Protection earth terminal(exterior case)
Dielectric strength	2,300 V AC. 50 / 60 Hz, for 1 min (input terminal–Power terminal, power terminal–protection earth terminal)

Control function and output

Control type	PID auto tuning
Control action	Reverse action (heating), direct action (cooling), By the internal setting (SL9)
Range setting	Same as input range chart
Proportional band	0 ~ 100 % of FS.
Integral time	0 ~ 3,600 sec
Differential time	0 ~ 3,600 sec
A.R.W(Anti Reset Wind-up)	Auto(A=0), 0 ~ 100 % of FS.
ON/OFF control	Perform the ON/OFF control if proportional band is set as 0
Hysteresis when performing ON/OFF control	0 ~ 10 % of FS.
Control loop break alarm	1 ~ 7,200 sec (Generally set twice as the integral time)
Proportional cycle	1 ~ 100 sec
Position of decimal points selection	1 ~ 4 (000.0 with setting 2)

Retransmission output	4 – 20 mA DC (measured value)
Alarm type	high alarm(ALH), low alarm(ALL), high and low alarm within the range (deviation setting, absolute setting)
Alarm setting range	0 ~ 100 % of FS.
High alarm hysteresis(ALH) setting	0 ~ 10 % of FS.

● Output

Control output	Relay output	contact capacity : 1c, 250 V AC, 5 A (resistive load)
	SSR	approx. 12 V d.c (resistive load min 600 Ω)
	Current	4 – 20 mA DC (resistive load max 600 Ω), accuracy : ±0.2 mA
Alarm output	Temperature alarm (relay)	DX4 alarm output : high, low alarm, LBA common, 1 a X 1 contact High alarm (ALH) : 1 C X 1 contact (but DX7 is 1 a X 1 contact)
	LBA (relay)	Low alarm (ALL) : 1 a X 1 contact 250 V AC, 5A (Resistive load)
Retransmission output	Current	4 – 20 mA DC (Resistive load max 600 Ω), accuracy : ±0.2 mA.

Standard specification

Power Supply Voltage	100 – 240 V AC, 50 – 60 Hz, 24 V DC/AC, 50 – 60 Hz (selectable by the suffix code)
Voltage fluctuation	±10 % of Power Supply Voltage
Power consumption	12 VA (100 – 240 V AC, 24 V AC), 4.5 W (24 V DC)
Ambient temperature	0 ~ 50 °C
Ambient humidity	35 ~ 85 % RH (without dew condensation)
Storage temperature	–25 ~ 65 °C
Vibration	10 – 55 Hz, 0.76 mm, X, Y, Z 2 hrs each in 3 axis direction
Shock	300 % to the direction 6 for 3 times each
Weight	DX9 : approx. 472 g, DX7 : approx. 344 g, DX4 : approx. 342 g, DX3 : approx. 340 g, DX2 : approx. 342 g

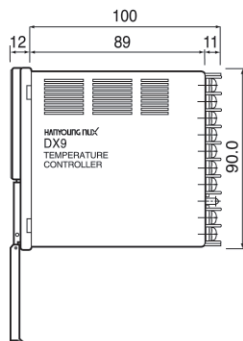
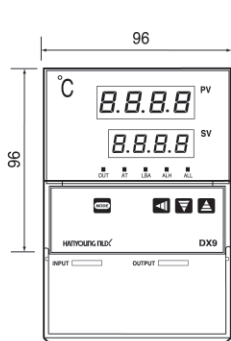
Range and input code (Select by suffix code. Do not change SL1 parameter)

Classification	SL1	Input	Range (°C)		Accuracy
Thermocouple	0001	K	K	–50 ~ 1,300	–50.0 ~ 999.9
	0101	J	J	–50 ~ 600	–50.0 ~ 600.0
	0100	R	R	0 ~ 1700	0.0 ~ 999.9
RTD	0010	D	Kpt100 Ω	–199 ~ 500	–199.0 ~ 500.0
	0011	P	Pt100 Ω	–199 ~ 640	–199.0 ~ 640.0
Voltage/current	0000	V	1 – 5 V DC	–1999 ~ 9999	decimal points is due to the SL4
	0000	C	4 – 20 mA DC	–1999 ~ 9999	
	1111	F	0 – 10 V DC	–1999 ~ 9999	

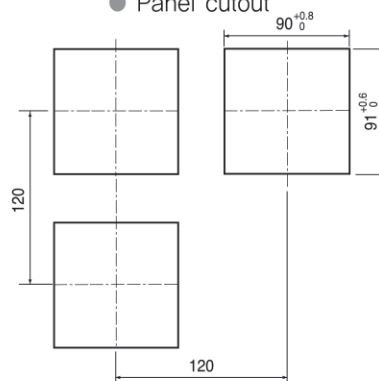
Dimension and panel cutout (Unit : mm)

DX9

Dimension

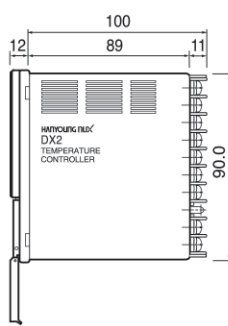
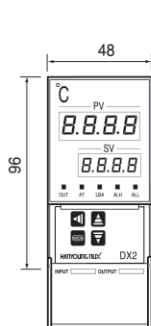


Panel cutout

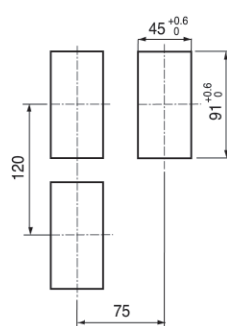


DX2

Dimension

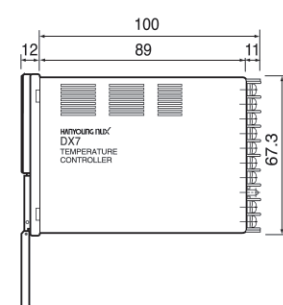
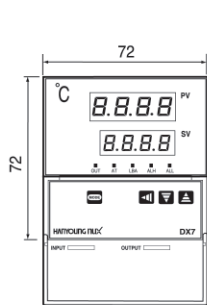


Panel cutout

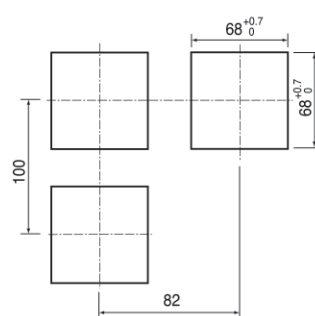


DX7

Dimension

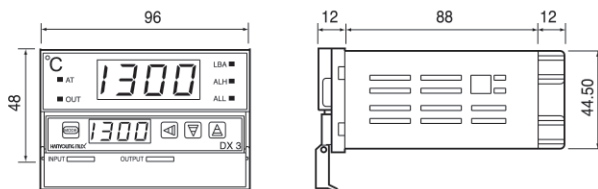


Panel cutout

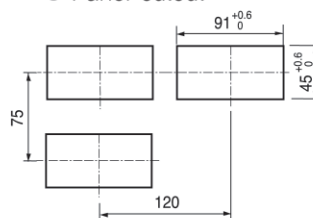


DX3

● Dimension

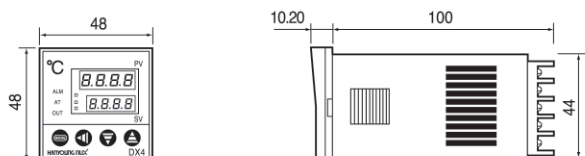


● Panel cutout

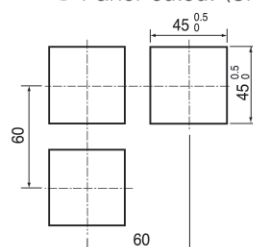


DX4

● Dimension (Unit : mm)

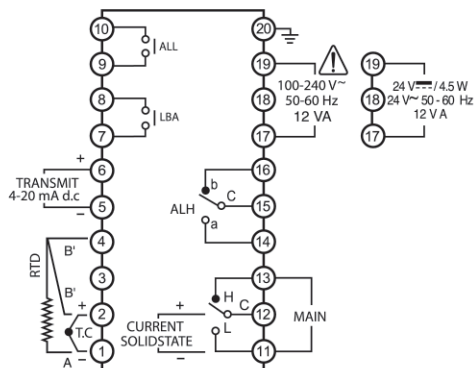


● Panel cutout (Unit : mm)

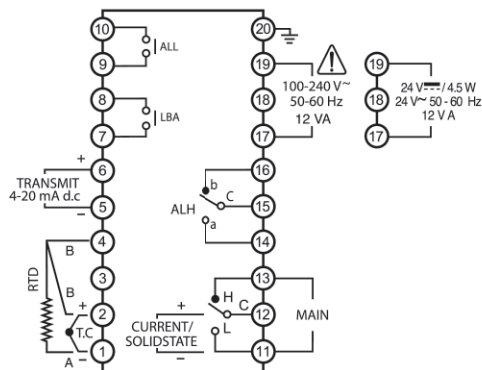


●● Connection diagram

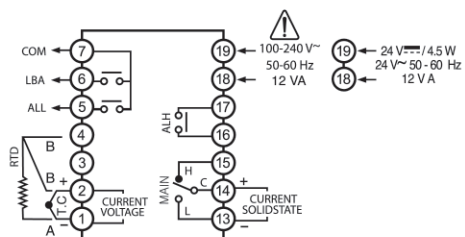
● DX 9



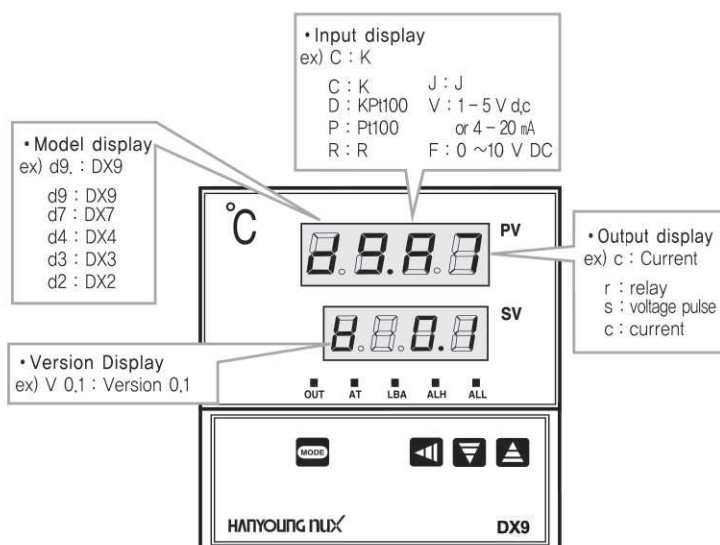
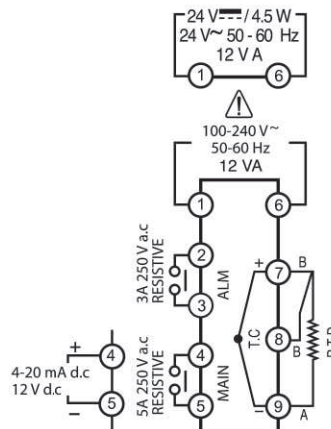
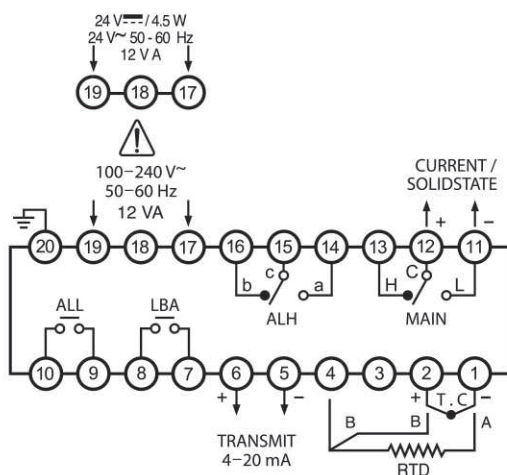
● DX 2



● DX 7



● DX 4



■ Max range and min range exceeded indication

- ① When PV increases due to the break or short of input and if it exceeds the max temperature range because of the PV increment, then the indication **□□□□** will flicker in the PV display unit which indicates that the value has exceeded the max range
- ② If PV decreases and exceeds the min temperature range then the indication **□□□□** will flicker in the PV display unit which indicates that the value has exceeded the min temperature range

■ Auto tuning function

The auto tuning function automatically measures, computes and set the optimum PID and ARW constants. The Auto tuning function is activated any time from any process states after power on while temperature is rising or when control is stabilized.

- (1) Perform auto tuning after finishing setting up functions other than PID and ARW
- (2) Press the **MODE** key and **▲** key synchronously then lamp of AT indication will flicker and auto tuning will begin.
- (3) When auto tuning finishes performing then AT indication lamp will stop flickering automatically. Press **MODE** key in consecutive order in order to check for constant by auto tuning.
- (4) When changing the constants which were set by the auto tuning automatically, please follow the setting instruction of each parameters and change them.
- (5) When users want auto tuning function to be suspended, press the **MODE** key and **▲** key synchronously then AT indication lamp will stop flickering and auto tuning will stop operating. In this case, PID and ARW each constant will not be changed (maintain the constant before auto tuning starts).
- (6) When users want to change the SV (set value) during auto turning is performing, first of all, please suspend the auto tuning function and perform the PID control by using the values before auto tuning starts.

■ Set data lock function

The set data lock function is used to prevent the changing of each set value by the front panel key and the activation of the auto tuning function. Please use it for preventing any malfunction after setting is completed. Set data lock display LOC by using **MODE** key, and then set the following value in accordance with parameter setting procedure thereby enabling data lock ON or OFF.

0000 : deactivate the set data lock function.

0001 : only able to change the set data lock indicated set value.

All of other data and AT function will be locked with other settings.

■ Control loop break alarm (LBA function)

(1) Setting procedure

Please set the set value of the LBA to a value of twice as the integral time. The LBA also can be set by the auto tuning function. In this case, the set value will be set to a value of twice the integral time automatically.

(2) Description of operation

LBA function starts to measure the time from the moment that the PID Computed Value (Output ON time/cycle) becomes 0% or 100%, and detects the changed amount of process value at each LBA setting time, and determines ON and OFF of control loop break alarm by the corresponding amount of changed value.

- ① When the status at a 100% PID computed value continues beyond the LBA setting time, the control LBA will be turned ON if the measured value (PV) does not rise by 2 C or more. (With forward operation, ON if it does not fall by 2 C or more)
- ② When the status at 0% PID computed value continues beyond the LBA setting time, the control LBA will be turned ON if the measured value (PV) does not fall by 2 C or more. (With forward operation, ON if it does not rise by 2 C or more)

(3) Causes of operation

The LBA is operated under the following conditions.

- ① controlled object trouble: Heater break, no power supply, incorrect wiring and etc.
- ② sensor trouble: disconnection or short of sensor.
- ③ actuator trouble: burnt relay welding, incorrect wiring, does not get turned ON.
- ④ output circuit trouble: relay welding inside of the instrument cannot ON or OFF.
- ⑤ input circuit trouble: the measured value does not get changed even if input value changes and etc.

* If causes of the above trouble cannot be identified then please check the control system.

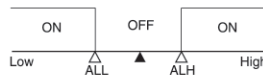
■ ON/OFF control setting method

Usually temperature controller performs the temperature control by "PID control method" which is by the PID auto-tuning. However, ON/OFF control method is used when controlling refrigerator, fan, solenoid valve and etc. When users want to set the temperature controller as ON/OFF control mode, set the set value of proportional band as 0 in the "general setting parameter". Here, HYS (hysteresis) parameter will be displayed. Prevent such actions by setting the desired ON/OFF action range.

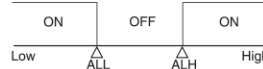
Parameter symbol	Name	Set range	Default value
P	Proportional band	0 ~ 100 %	20 %
	Set the proportional band as "0" when using ON/OFF control. However, performing PID auto-tuning when using the ON/OFF control, it will be changed to PID control		

■ Alarm function

※ Alarm operation can be set as following diagram (▲: set value (SV) △: alarm set value)

Deviation alarm setting	High and low alarm	
	Alarm within range	

This is the setting method that activates the alarm once the temperature goes over or under the set value. For example, if users want to activate the alarm high (ALH) at 205°C and alarm low (ALL) at 190°C when the set temperature is 200°C, set 5 c at the alarm high (ALH) and 10°C at the alarm low (ALL). Also, if users change the set temperature to the 300°C, alarm high (ALH) will be activated at 305°C and alarm low (ALL) will be activated at 290°C.

Absolute alarm setting	High and low alarm	
	Alarm within range	

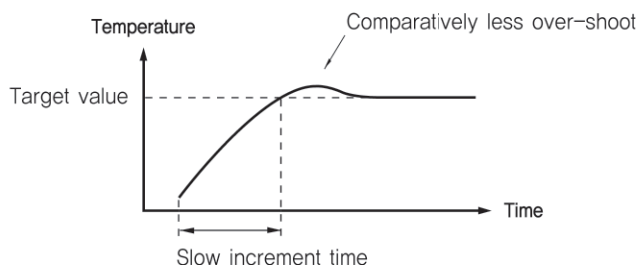
Activate the high and low alarm at the set temperature disregarding the main set value.

※ With the alarm within the range, alarm low (ALL) relay does not get activated and only alarm high (ALH) relay is activated.

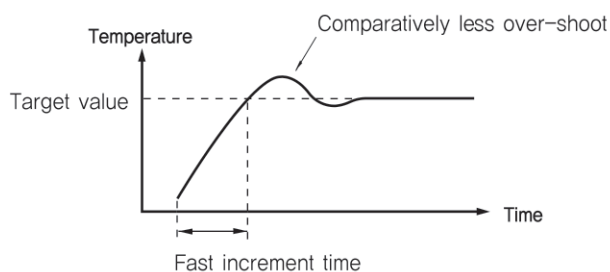
■ Anti reset wind-up (ARW)

Set the over integral preventing function at the "A" parameter

① control with A=Auto (0)

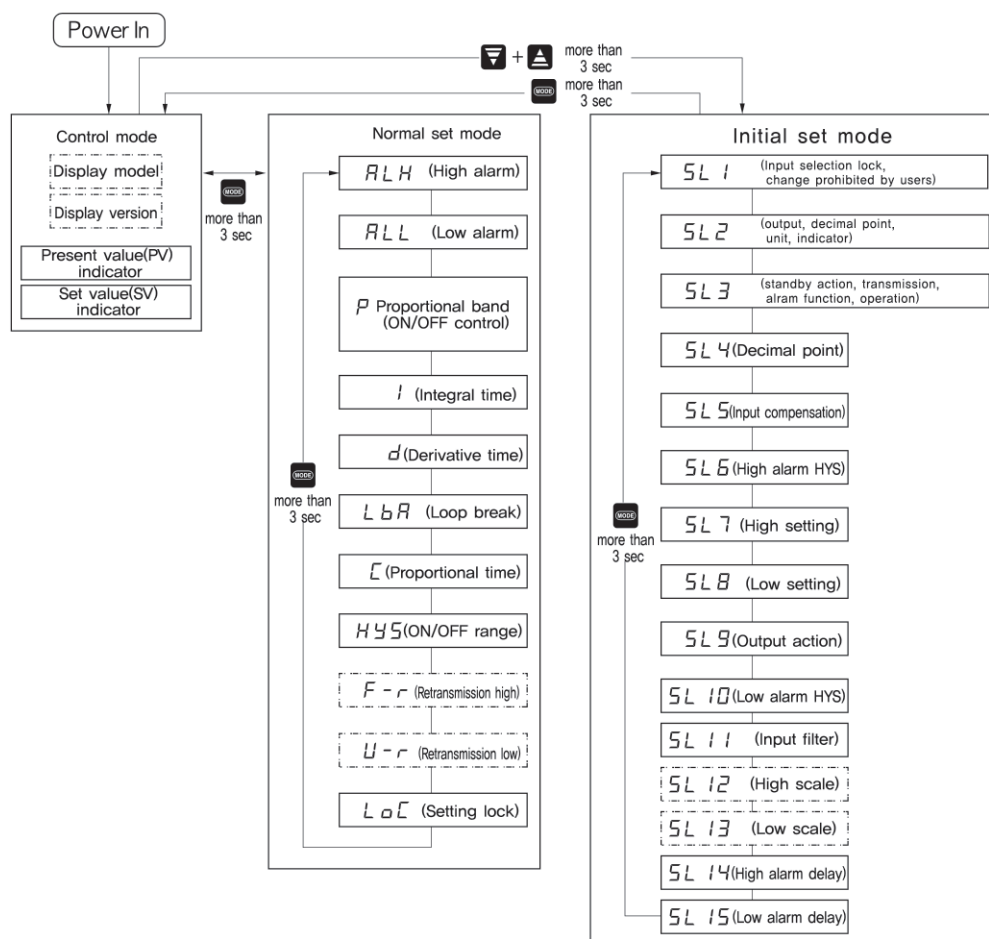


② in case when temperature is set in A



※ If A value is too small, large over shoot or under shoot may occur
Please use it by setting the value same as P (proportional band)

Parameter composition



Parameter setting

■ Control temperature setting

Supplying the power in after completes the wiring, it will display the model and version of temperature controller for a while and display measured temperature and set temperature. This state is called as control mode.

Pressing the  key in the control mode state will flicker the set value in the indicator.

■ General mode setting

General mode is the setting mode which sets alarm set value, ON/OFF action, hysteresis (HYS) and etc which are required to change the set value frequently. It is set each parameter on occasion demands.

But, performing the PID auto-tuning will automatically set P (proportional band), I (integral time), d (derivative time), R (anti reset wind up), LbA (control loop break alarm) and etc

■ Normal setting mode

*(Press the  key for 3 seconds continuously.)

Present value display unit	Name	Setting range	Explanation
*1 	High alarm (ALH)	within the input range	display the set value of high alarm.
*1 	Low alarm (ALL)	within the input range	display the set value of low alarm.
	Proportional band (P)	0~100% FS	set when performing the proportional control. Setting to '0' will become ON/OFF control.
	Anti reset wind up (ARW)	0~100% FS	prevents overshoot and undershoot caused by integral effectiveness. Automatically operates with setting '0'.
	Integral time (I)	0~3600 S	Eliminates offset occurring in proportional control, and read the target value faster Integral action will be turned OFF with setting '0'.
	Derivative time (D)	0~3600 S	prevents ripples by predicting output change thereby improving control stability. Derivative action will be turned OFF with setting '0'.
	Control loop break alarm (LBA)	0~7200 S	Indicates control loop break alarm setting. Cancel the control loop break alarm with [0] setting
	Proportional cycle (C)	0~100 S	Displays control output cycle (sec).
	Hysteresis (HYS)	0~10% FS	set the control sensitivity of control output (with ON/off control)
*2 	High Retransmission output	within the input range	limits the max value of Retransmission output
*3 	Low Retransmission output	within the input range	limits the min value of Retransmission output.
	Set data lock (LOC)	0~3	0000:Lock cancellation, 0001:Possible to change only SV

* 2 and 3 is optional (not displayed when there is no retransmission output)

(DX4 and DX7 are not included in the retransmission output optional)

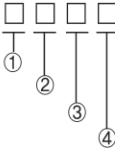
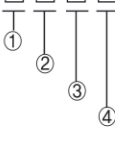
* 1, changing ALH, ALL to SL3 become reset

■ Initial set mode

The system mode sets the temperature controller's specification when it is set first by engineer pressing

 key and  key synchronously in the control mode for 3 sec will enter in to the system mode.

Return to the setting mode(PV/SV) by pressing  key to 3 sec

Symbol (PV display screen)	List	Description	Reference
SL1	Input selection	By the suffix code (fix, change inhibit) "Refer to the range and input code"	
SL2 	① Output selection	0 : current output 1 : relay, voltage output	
	② Decimal points function selection	0 : Decimal point display 1 : No decimal point	
	③ Temperature unit selection	0 : None 1 : Celsius(°C)	
	④ Indicator/ controller selection	0 : Temperature indicator 1 : Temperature controller	
SL3 	① Alarm standby operation selection	0 : Yes 1 : No	
	② Retransmission output (Optional)	0 : Yes 1 : No	
	③ Alarm type selection	0 : Alarm within range 1 : high and low alarm	
	④ Deviation/ absolute alarm selection	0 : deviation alarm 1 : absolute alarm	
SL4	Position of decimal point selection	000.0 is indicated when it is set as 2	When users want to display the decimal points on the first digit, set as 0002
SL5	Input compensation setting	±100 % of FS	
SL6	Alarm high (ALH) Hysteresis setting	0 ~ 10 % of FS	
SL7	Max temperature setting	Within Temperature setting but, SL7 > SL8	Refer to the range and input code
SL8	Min temperature setting		Refer to the range and input code
SL9	Output operation (control direction)	0 : reverse operation (heating operation) 1 : direct operation (cooling operation)	0 : reverse operation 1 : direct operation
SL10	Alarm Low (ALH) Hysteresis setting	0 ~ 10 % of FS	
SL11	Input filter	0 ~ 100 sec	
SL12	Max input scale setting	9999	Applied with voltage input
SL13	Min input scale setting	-1999	Applied with voltage input
SL14	Alarm High (ALH) delay time setting	0 ~ 100sec	
SL15	Alarm Low (ALL) delay time setting	0 ~ 100sec	

(Press the  key.)